

Zero Retries issue 0030 2022-01-28

Advanced Amateur Radio - Data Communications; Space; Microwave... the fun stuff! The Universal Purpose of Ham Radio is to have fun messing around with radios - Bob Witte K0NR. Ultimately, amateur radio must prove that it is useful for society - Dr. Karl Meinzer DJ4ZC. We are confronted by insurmountable opportunities! - Pogo. Nothing great has ever been accomplished without irrational exuberance - Tom Evslin. Irrational exuberance is pretty much the business model of Zero Retries Newsletter - Steve Stroh N8GNJ.

Steve Stroh N8GNJ, Editor

Jack Stroh, Late Night Assistant Editor

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Reminder - ARDC's first Community Meeting of 2022 will be held via videoconference on [Saturday 2022-01-29 at 10:00 Pacific](#). Hope to see some of you there!

Request To Send

Breaking News! The Zero Retries subscriber count just broke 250! Thanks folks!

Countdown to [Hamvention](#) 2022 - May 20-22, in Xenia, Ohio - 16 weeks...

As you'll undoubtedly note, there is a significant amount of information in this issue that isn't (directly) about Amateur Radio. It's not by design, but it's not entirely by accident - it just so happened that there were a number of "Zero Retries Interesting" stories worth telling this week that didn't happen to directly overlap with Amateur Radio. That will happen from time to time. Advanced Amateur Radio, and thus Zero Retries coverage of Advanced Amateur Radio, has never been solely about "Amateur" or "Radio".

"This I Believe - N8GNJ's (and Zero Retries') Vision of Amateur Radio in 2022 and Beyond" (mentioned in Zero Retries 0029) *still* didn't get enough keyboard / butt-in-chair time this week, so I'm punting it ahead one issue yet again. Among other tasks this week, I spent a day [doing an update](#) on the Mount Baker Amateur Radio Club Digital Group's "info" page. I've observed that one of the biggest barriers to newcomers to Amateur Radio, once they obtain their Amateur Radio license, is just *where to start*? I tried to provide pointers for new and prospective Amateur Radio operators in Whatcom County that are interested in data communications. Admittedly it's too wordy and needs to be "sectionalized", but it's now minimally usable and reasonably informative.

Long time subscribers to Zero Retries might recall my fondness for the Radio Shack Color Computer which I mentioned wayyy back in Zero Retries 0005. In an email exchange about his great YouTube channel [The CoCo Collector](#), my friend from the CoCo world Boisy Pitre KF5HEL mentioned that **The 30th Annual "Last" Chicago CoCoFEST!** will be held 2022-05-14 and 15 in Elk Grove Village (Chicago), Illinois. Apparently I'm way behind on my CoCo Community news; CoCoFEST! has previously been held in the *Fall*. Given that CoCoFEST! 2022 is the weekend before Hamvention, and Elk Grove Village is a mere 337 miles and 5'ish hours travel (via Indianapolis) to Xenia, I am going to try mightily to attend both CoCoFEST! and Hamvention in 2022.

de N8GNJ

CHIRPING INTO THE WORLD OF LORAWAN

This is another great "Amateur Radio Adjacent" article from [Hackaday](#). Discussion of LoRa use in Amateur Radio has been on the list of "deep dive" subjects for Zero Retries since its beginning. Until I get that done, the [full article](#) is a decent primer on LoRa.

The proprietary [LoRa](#) RF modulation technique that underlies LoRaWAN is based on Chirp Spread Spectrum ([CSS](#)). This modulation technique is highly resistant to channel noise and fading as well as Doppler shift, enabling it to transmit using relatively low power for long distances. LoRaWAN builds on top of the physical layer provided by LoRa to then create the protocol that devices can then use to communicate with other LoRa devices.

...

LoRaWAN has a [best-case data throughput rate](#) (Adelantado et al., 2017) of a few tens of kilobits per second, depending on the spreading factor (SF). Here the SF is essentially the ratio for how fast the transmitted signal is being sent: a higher SF

(up to 12) means a slower transmission and thus lower bandwidth (<1 kbps), but with increased reliability. A lower SF (down to 7) means that the signal is being transmitted faster, thus with higher bandwidth, but with possible loss of reliability.

Although LoRa is proprietary, it's very "hackable" and is being used widely by hobbyists and for many varied applications, including satellite communications (yes, I'm amazed at that also). LoRa's creator designed it specifically for operation in license-exempt spectrum where very low power is required, and interference is inevitably present.

LoRaWAN is extended networks of LoRa nodes, usually with some kind of Internet access, usually requiring subscription fees to access. In Europe, 433 MHz is usable as low-power license-exempt, but of course in the US and other countries, 433 MHz is within Amateur Radio spectrum allocations. That doesn't stop a lot of experimenters (without Amateur Radio licenses) from using it in the US.

LoRa, and LoRaWAN is yet another example of proprietary implementations of technologies that could (with applied effort) be replicated as open source technologies and customized for use in Amateur Radio. In LoRa's case, Chirp Spread Spectrum is a well-documented technology and Amateur Radio has access to inexpensive and powerful software defined transmitters and receivers that could implement CSS as "just software". Other examples of such potential projects that are currently only available as proprietary implementations are [VARA FM](#) (integration of OFDM, Forward Error Correction, varying modulation index, etc.) and [Digital Mobile Radio](#) (though [M17 Project](#) is working hard on an open source equivalent, notably the use of an open source CODEC).

Dedicated Processors for Modems, Versus Software Modems on Host Computers

From his work on the Winlink Development Team, Rick Muething KN6KB knows a thing or six about designing effective modems. I saw this on the VARA-MODEM list and found [his perspective on this topic](#) enlightening.

A couple of things I might add that are often overlooked :

- The trend of the past several years of using "software modems" running on non real time OS machines (Windows, Mac OS, Linux, etc) doesn't often address the significant problem of real time delays caused by the OS and what other programs may be running. The typical exchange of data with an ACK/NAK involves the requirement of software modems (running on non real time operating systems) to accommodate the delays that are determined by BOTH the decode process (software modem doing DSP) AND the OS latency (this can be 100 ms or more depending on software modem implementation, Sound card latency etc.) This can have a significant impact on throughput since the timing in the Data + ACK/NAK exchange must normally accommodate the worst case anticipated delays.
- The cost of high performance Dedicated Microprocessors with very good

Real time capability (e.g. Teensy 4.x running the Arduino C++ code) has dropped significantly and now rivals or exceeds the DSP capability of some of the earlier Pactor 2 and 3 modems. While a dedicated CPU (e.g. like a Teensy/Arduino) is not a zero cost item (like a free Software modem) it has a number of advantages:

- Significantly reduces the demands of the host OS response times and CPU loading.
- Allows the host OS interface to be a much simpler program (and easier to maintain and adapt) since it is not required to do real time DSP and critical Data/Ack/Nak timing. This dramatically reduces the programming support required to “interface” a protocol to multiple operating systems, computers, and OS revisions.
- Allows building more complex and sophisticated modems (e.g. Dynamic path compensation like used in STANAG and Mil Std 188 modems) that are normally outside the capability of software implementation on non real time OS hosts.

All this should remind us of the "No Free Lunch" theorem!!! (which we too often forget when requesting free software with unlimited free support!)

Some Thoughts on Amateur Radio 902-928 MHz

I was having an email conversation with another Amateur Radio Operator and they asked my opinion of doing advanced (faster, more complex modulations) data communications in the (US and Canada) Amateur Radio 902-928 MHz band. My reply ended up being lengthy, and it seemed reasonable to repurpose it into a small article.

In my opinion, 902-928 MHz is a great Amateur Radio band. It has the benefit of being low enough in frequency to not be totally attenuated by foliage, unlike 2.4 GHz and above. It's not quite at the threshold of microwave operations - you can still use coaxial cable, yagi antennas, even omni antennas (but, good quality). That's the good news.

The bad news is that 902-928 MHz has been discovered by (and now dominated by) the utility companies who have deployed license-exempt radios in sufficient density to create a reliable network for low data rate meter reading and other uses. [Amazon's Sidewalk \(Mesh\) Network](#) also operates in 902-928 MHz. Thus, if you look at 902-928 MHz with a spectrum analyzer you'll see it's just an absolute mess of signals, especially in cities and suburbs where there can be as many three separate radios chirping away for every residential unit (water, gas, power), not to mention all the units on the poles. Another issue is that 902-928 MHz is allocated for Industrial, Scientific, Medical (ISM, or Part 15, or just “license exempt”) / Amateur Radio pretty much only in the US and Canada, thus there are not many "cheap radios" available. Correction - there do seem to be an increasing number of LoRa (Long Range) slow speed data modules for “915” MHz, and of course, there are commercial Land Mobile Radios for 900 MHz that can be re-channelled for 902-928 MHz if you want to run “sound card modem” speeds

in 902-928 MHz.

Wireless Internet Service Providers (WISPs) tried using 902-928 MHz (despite the “mere” 26 MHz of spectrum there). The WISP equipment providers tried to make suitable systems, but consumer demands for higher speeds forced the WISPs to largely abandon 902-928 MHz. The only recourse for the WISPs to continue operating in 902-928 MHz, like the utilities, was to deploy very densely, such as just a few miles between the base station and the clients.

There's good news for Amateur Radio in 902-928 MHz. We're licensed. Part 15 users and devices are not. Part 15 devices are required to “...accept interference even when such interference causes undesirable operation”. Thus Amateur Radio Operators have carte blanche to run higher power. *The problem is decoding a signal out of the incredible noise.*

I think the path forward for Amateur Radio in 902-928 MHz is:

- Use a software-defined transceiver.
- Use a lot of forward error correction.
- Use Frequency Hopping Spread Spectrum (or Chirp Spread Spectrum - see previous article).
- Use narrow channels (more hops).
- Use more power - 10, maybe even 25 watts.

It's sobering that Hedy Lamarr and George Antheil created Frequency Hopping Spread Spectrum (FHSS) in **1941** ([nice article from FreeWave](#)). That makes FHSS only slightly younger than Frequency Modulation. Despite the eighty years since its invention, and it being implemented with 1960s military technology, Amateur Radio with all its advances in cheap computation capability, Digital Signal Processing, and amazing software expertise *still hasn't implemented FHSS* for use in Amateur Radio. TAPR *tried* (twice!) with their [FHSS Radio Project](#) beginning in 1997. I think FHSS was what FaradayRF was onto, before they ran out of "hobby project" momentum a few years ago.

Fortunately one company didn't get the “no one does FHSS” memo. If you want to build a reliable network on 902-928 MHz with Part 15 devices (no Part 97 limitations like no encryption, etc.) and you're willing to pay commercial prices, look at the [Zumlink series](#) from [FreeWave Technologies](#). FreeWave has been doing 902-928 MHz FHSS Part 15 radios for than three decades. FreeWave units aren't cheap, but they're not government / military expensive either. FreeWave's units *work* - even mobile. Their range is impressive, especially with external antennas. They also have a mesh networking capability.

For all this “Advanced Amateur Radio” stuff, including equipment for 902-928 MHz, what we *really* need right now is software engineers who understand DSP, modulations, and also understand the nuances of Amateur Radio Operation. Once you have the code, you can just flash it over into one of the many Software Defined Transceivers that can do 902-928 and 1240-1300 MHz. Yes, those transmit at peanut power levels, but driver amps and power amps aren't rocket science. In my opinion, tinkering with "Direct 902-928 MHz" and "Direct 1240-1300"

hardware is doing it the hard way; we already have hardware that can get to those frequencies; what we need *most* is the “Amateur Radio specific” software to drive that hardware.

STEM is Hard for *Everyone*

This retweet surfaced in the Zero Retries Twitter feed ([@zeroretries](#)), and it was worth bumping another article to include it here. It's especially poignant to me on this particular publication day.

(Wow, didn't know I could *do* that - Thanks Substack!)

I wish we had a better system than “grades”. My grades weren't stellar either. (I have to disclaim, first, that I had the incredible privilege of supportive parents that enabled my post-secondary education.) What made it possible for me to be successful in some way was my native curiosity, reading everything I could get my hands on about my areas of interest (not just assigned textbooks), and being able to experiment with little computers and later radios (Thank you Amateur Radio!). Having experience in Amateur Radio, specifically TCP/IP, made possible a major turning point in my career. Zero Retries is part of paying it forward to Amateur Radio for having been a self-education lifeline for me.

ZR > BEACON

- **~~Two~~ Three and a Half Amateur Radio Operators Appointed to FCC Technological Advisory Committee (TAC)** - [ARRL News 2022-01-20](#)

FCC Chairwoman Jessica Rosenworcel named two prominent radio amateurs among her appointments to the FCC Technological Advisory Council (TAC) on January 19.

Appointed were Greg Lapin, N9GL, and Michelle Thompson, W5NYV. Lapin chairs the ARRL RF Safety Committee and has represented ARRL The National Association for Amateur Radio on the TAC since 2001.

...

Thompson is CEO of the Open Research Institute (ORI), which she will represent on the TAC.

Per an update in [ARRL News 2022-01-27](#):

Andy Clegg, W4JE, was also appointed to the TAC to represent the Wireless Innovation Forum. Dale Hatfield, ex-W0IFO, was another TAC appointee.

You know what they call ~~two~~ three and a half Amateur Radio Operators on the FCC Technological Advisory Committee? **A Good Start** 😊

- **James Webb Space Telescope Now Positioned at Lagrange 2**

Nothing to do with Amateur Radio, but the tech of the James Webb Space Telescope is just... so... *amazing*! In saying this next, I'm not intending to detract in any way about the vision, engineering, people, manufacturing, launch, and deployment... which is just about some of the proudest engineering humanity has ever accomplished. But, what really strikes me about JWST is that it will [operate](#) at Lagrange 2, a null gravity point in space ideal for a space-based telescope such as JWST. I was under the mistaken

impression (ignorance on my part) that JWST was the first object to be parked at any of the Lagrange Points, but the Wikipedia's article [List of objects at the five Lagrange Points](#) educated me otherwise. It's cool to hear "L2" mentioned in tech articles.

Update

- [EASAT-2 and HADES Update](#) (Re: Zero Retries 0028) *We confirm the reception of both EASAT-2 and HADES, as well as the decoding of telemetry and the FM recorded voice beacon with the callsign AM5SAT of the first one. EASAT-2 appears to be working well except for the deployment of the antennas, something that apparently has not yet occurred and causes weak signals. However, the AMSAT-EA team confirms that, based on the reception of FSK, CW, the FM voice beacon and the telemetry data that has been decoded, it can be said that the satellite is working perfectly. In the event of low battery or system malfunction, the on-board computer would not transmit CW messages or the voice beacon-callsign, as it would be in a 'safe' state with only fast and slow telemetry transmissions.*
- **A little bit more on Silent Keyboard N1URO** (Re: Zero Retries 0028) As someone who's been involved in Amateur Radio Packet Radio for a long time, this is a poignant tribute [from Niels Ruiter PD9Q](#) on the passing of "packeteer extraordinaire" Brian Rogers N1URO:
This is very sad news. I have been in regular contact with him over the years. He was always willing to help you with packet/amprnet related things. He always had his own opinion on certain things, and he couldn't be changed. I didn't always appreciate this. He will be missed, packet land is a bit more empty.
Till next time.
N1URO to PIILAP ttl 25 cct=01F0 <DISC REQ>
04:55:35T PIILAP>N1URO Port=7 <RR R F R5>
04:55:35T PIILAP>N1URO Port=7 <I C P S7 R5> NET/ROM
PIILAP to N1URO ttl 25 cct=035D <DISC ACK>
- **Credit where due - Inductive Twig** (Re: Zero Retries 0028) Five days before I would have initiated a claim with my credit card issuer for non-delivery and non-communication after my order on 2021-12-30, [Inductive Twig](#) claims to have shipped my items. Still no direct communication from them, just the shipping notice. Per their web page, their business shutdown may have been chaotic ("skeleton crew"), but they've done their part for Amateur Radio by posting [some open source documentation on Github](#), including hardware data for [HamShield 1.0](#).

Feedback Loop - Zero Retries 0029

- **Rich Casey N5CSU (via email):** *Hi Steve. The feedback button in the [Substack] email doesn't work for me from Gmail on the iPad, so I looked your email up on [qrz.com](#). (I was surprised that you don't have any info in your bio section, or even a mention of Zero Retries).*
Anyway, just a note to say I appreciate your weekly post very much. I've been on packet

since the early days, where I hosted a BBS on a TRS-80 Model 100. I have APRS running everywhere and host an EchoLink simplex node for my neighborhood radio club (wa5wrl.org). AREDN arednmesh.org is quite popular in the north Texas area, with clubs sponsoring nodes at repeater sites. Anyway, thanks for keeping the flame going and the digits flying!

□Rich - There are quirks in Substack and apparently you found one. Thanks for persisting and the kind words. You're right - I should update my page on QRZ. I miss the BBS days. I hope to get one on the air here in Whatcom County. (Per N5CSU's "nudge", I did update [my QRZ page](#).)

- **Bob Adkins KE8EC (via email):** *Greetings from Rio Grande Ohio!*

I'm glad I stumbled across "Zero Retries" on the 'net. Learning much! However it also indicates just how far back in the Dark Ages my digital operations are!

Bob - The truth is, most of us Amateur Radio Operators interested in "hands-on" data communications in Amateur Radio are staring at a learning curve that looks like a sheer cliff given the obscene wealth of technology we have available to us in this era. Just *one little advancement* - the \$35 Raspberry Pi computer has *utterly transformed packet radio* into an incredible tool for those interested in experimenting with data communications via radio. (Heck, the RPi is *so* powerful, [with just software it can be a radio transmitter!](#)) The RPi enabled the creation of a software version of the venerable Terminal Node Controller called [Dire Wolf](#) that is just [astonishing in its capabilities](#) (YouTube video) including *two* Forward Error Correction schemes.

The problem I'm trying to address with Zero Retries is that very, very little of this incredible... and accessible... technology is being openly discussed by what I've taken to calling "The Amateur Radio Publication Industrial Complex" that most Amateur Radio operators trust to keep them informed of what's happening in Amateur Radio.

Writing about all of these amazing new capabilities (more *every day*) is surprisingly hard. For me it's like trying to drink from a firehose every day and then trying to distill all these developments into a weekly email newsletter that's compact enough that your email provider won't reject it as spam. So, welcome to Zero Retries Bob, and please keep reading and learning along with the rest of us.

Join the *Fun* on Amateur Radio

If you're not yet licensed as an Amateur Radio Operator, and would like to join the fun by *literally having a license to experiment with radio technology*, here are some pointers:

- **Ham Radio for Dummies** by Ward Silver N0AX is a great overview of Amateur Radio. N0AX is a gifted writer and HRFD is now in its [4th edition](#).
- My two favorite **YouTube** channels for a good overview of Amateur Radio are [AmateurLogic.TV](#). and [Ham Nation](#) (part of Ham Radio Crash Course). These folks just seem to have so much fun!
- Dan Romanchik KB6NU offers a free **No-Nonsense Study Guide** for the [Technician test](#) (PDF).

- [HamExam.org Amateur Radio Practice Exams](http://HamExam.org) offers good **Flash Card and Practice Exams**.
- When you're ready to take an **Amateur Radio examination** (Tech, General, or Extra), W1MX - The MIT Amateur Radio Society offers [remote exams](#), free for students and youngsters. *There are apparently [many other remote exam options](#).*

Bonus - with an Amateur Radio license, you'll be [more attractive on dates](#) 😊

Closing the Channel

- My ongoing Thanks to Tina Stroh KD7WSF for, well, *everything (especially for keeping me going for most of my 62 trips around Sol as of today)*, Bill Vodall W7NWP as *Zero Retries Instigator in Chief*, and Larry Gadallah NM7A for his long term encouragement about Zero Retries.
- My ongoing Thanks to pseudostaffers [Dan Romanchik KB6NU](#), [Jeff Davis KE9V](#), and [Steve Lampereur KB9MWR](#) for continuing to spot, and write about “Zero Retries Interesting” type items, on their respective blogs, from Amateur Radio and beyond, that I don't spot on my own.
- [Southgate Amateur Radio News](#) consistently surfaces “Zero Retries Interesting” stories.
- The [Substack email publishing platform](#) makes Zero Retries possible. I recommend it for publishing newsletters.

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subscribers actually do read Zero Retries.

All previous issues of Zero Retries are available without restriction (no paywalls). For some background, Zero Retries 0000 was the **Introduction Issue**. Zero Retries 0026 and Zero Retries 0027 were a **2021 Year End Review** of Zero Retries.

More bits from Steve Stroh N8GNJ:

- [SuperPacket blog](#) - *Discussing new generations of Amateur Radio Data Communications - beyond Packet Radio (a precursor to Zero Retries)*
- [N8GNJ blog](#) - *Amateur Radio Station N8GNJ and the mad science experiments at N8GNJ Labs - Bellingham, Washington, USA*

Thanks for reading!

Steve Stroh N8GNJ

These bits were handcrafted in beautiful Bellingham, Washington, USA

2022-01-28

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